Space Weather Technical Forecast

Issued on Friday, 14 October 2022 at 13:11 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Decreasing chance of M-class flares. Active electron Fluence falling.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Moderate, with a long period M1.3 flare observed from AR3112, peaking at 14/0944 UTC. Both AR3112 and AR3116 are now on the limb, meaning observation of their evolution is now extremely difficult, and their previous classification will be assumed until they rotate off. The remaining four regions are all relatively small and simple, either unchanged or in decay. There are also a number of filaments on the Earth-facing disc, one of which erupted yesterday. The subsequent CME is expected to pass below Earth's orbit, although a glancing blow is possible.

Solar Wind / Geomagnetic Activity: The solar wind speed, as observed by ACE and DSCOVR at L1, has shown signs of the onset of a minor HSS from CH32, likely combined with some weak CME influence. Wind speeds were at background levels throughout, although they increased from 300 km/s to around 380 km/s. Density was average, increasing to above average around 14/0300 UTC with a peak of 27 ppcc. The total IMF strength, Bt, was weak at first but increased to moderate around 14/0300 UTC, jumping to strong at 14/0815 UTC. The north-south component, Bz, was weakly southward directed at first, before starting to vary moderately after 14/0300 UTC between +/-14 nT. The phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, has remained at background levels. High energy electron flux at GOES16 (greater than 2MeV) was at high levels, peaking at 4331 pfu at 13/1925 UTC, before dropping to background levels after 13/2250 UTC. The associated fluence has been above the Active (1e8 integrated pfu) threshold but with a declining trend. The 14/0000 UTC observation was 1.75e8 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is forecast to be mostly Low but perhaps Moderate, with a decreasing chance of M-flares, as AR3112 rotates off the visible disc. No significant regions are expected to rotate onto the visible disc.

Solar Wind / Geomagnetic Activity: Earth is currently experiencing a minor HSS from CH32/-, likely combined with weak CME effects from the filament eruption on the 9th. A further CME launched early on the 13th may also give peripheral glancing effects, most likely on Day 4 (17 Oct). The current HSS from CH32/- is likely to be fairly weak. Slightly elevated wind speeds are most likely but with the possibility of speeds reaching elevated levels. Wind speeds are expected to be at these levels into Day 2 (15 Oct), before easing into Day 3 (16 Oct). Geomagnetic activity is expected to be mostly Quiet to Unsettled, with a declining risk of Active intervals on Days 1 and 2 under combined HSS and CME influence and again on Day 4 with the risk of further peripheral CME effects.

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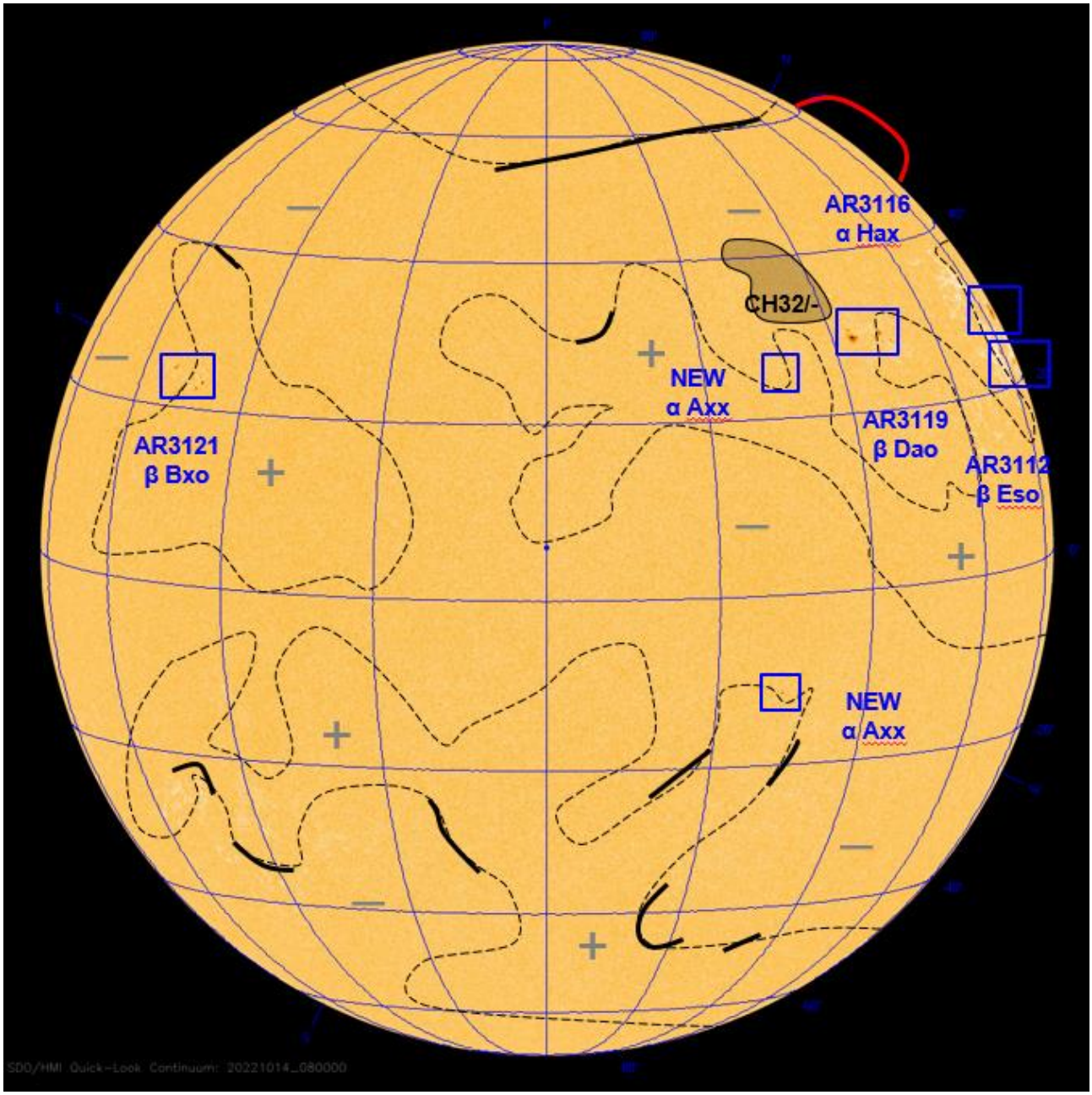
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at background levels, but with just a very slight chance of rising in response to any large flares from AR3112. High energy electron flux (greater than 2MeV) has dropped out to near background levels, although flux levels may recover somewhat during the period. The fluence is currently above the Active (1e8 integrated pfu) threshold and is forecast to drop in the near term, likely below Active. A further rise is possible through the period, perhaps to near Active levels, although confidence is low.

Figure 1. Solar Analysis Valid 14/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Earth is currently experiencing a minor HSS from CH32/-, likely combined with weak CME effects from the filament eruption on the 9th. A filament eruption from the southern centre disc early on the 13th has also produced a weak CME. Whilst the bulk of the material is expected to pass below Earth's orbit, peripheral glancing effects are possible, most likely on Day 4 (17 Oct). The current HSS from CH32/- is likely to be fairly weak, as it is a much smaller coronal hole than on the previous rotation. That said, wind speeds at STEREO-A appear to have reached above 500 km/s. As such, slightly elevated wind speeds are most likely but with the possibility of speeds reaching elevated levels. Wind speeds are expected to be at these levels into Day 2 (15 Oct), before easing into Day 3 (16 Oct).

Geomagnetic activity is expected to be mostly Quiet to Unsettled, with a declining risk of Active intervals on Days 1 and 2 under combined HSS and CME influence and again on Day 4 with the risk of further peripheral CME effects.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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Figure 2: Enlil is currently over-estimating wind speeds at Earth, with speeds more likely to peak around 400-450 km/s on the 15 Oct. The rise towards the end of the period is also considered to be overdone.

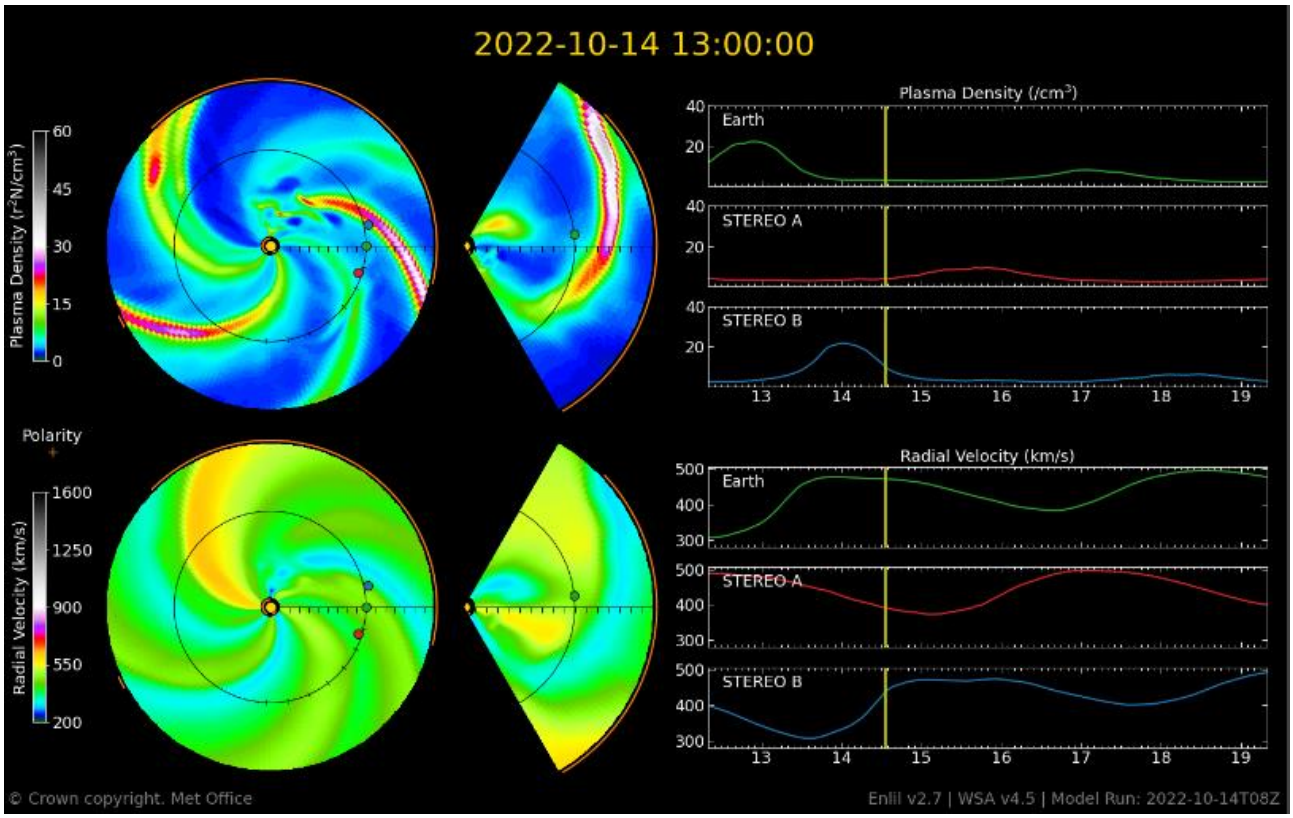
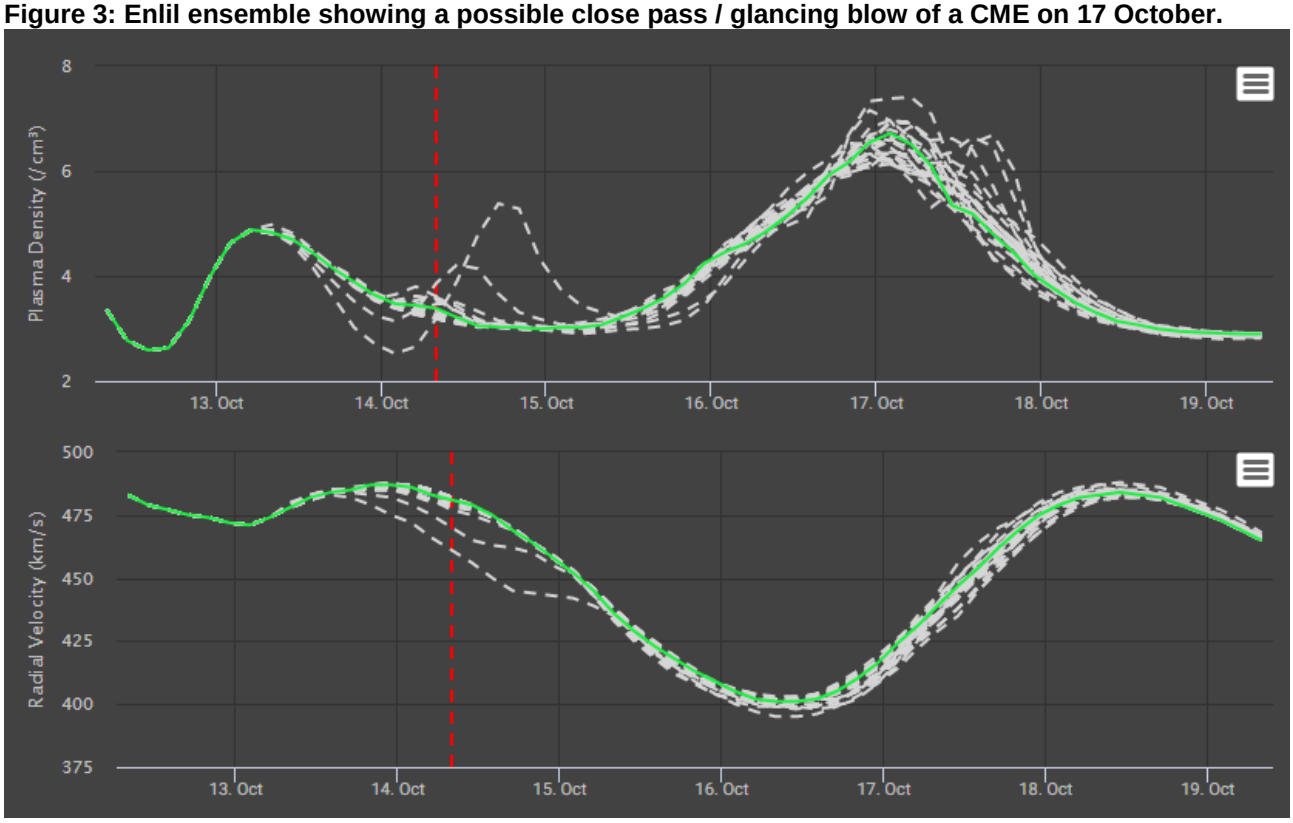


Figure 3: Enlil ensemble showing a possible close pass / glancing blow of a CME on 17 October.



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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

Activity has been Moderate with an M1.3 flare peaking at 14/0944 UTC from AR3112 (Eso/Beta) which is now on the northwest limb. Both AR3112 and AR3116 (Hax/Alpha) on the limb are now difficult to see and classify, so their previous classification is being assumed until they rotate off. AR3119 (Dao/Beta) and AR3121 (Bxo/Beta) are both relatively small and simple and have shown signs of decay, as have two very small new regions which are now fading.

However as AR3112 is currently rotating off the visible disc, with no significant regions are expected to rotate on, the risk of M-class flares decreases through the forecast period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	25	15	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) as observed by GOES-16 is currently at background levels. Despite M-flaring in recent days from AR3112, which is in a geoeffective location for proton storming, no observable increase in high energy proton flux has been observed. As such, the risk of radiation storms is very low, and decreasing as AR3112 rotates away.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	2	2	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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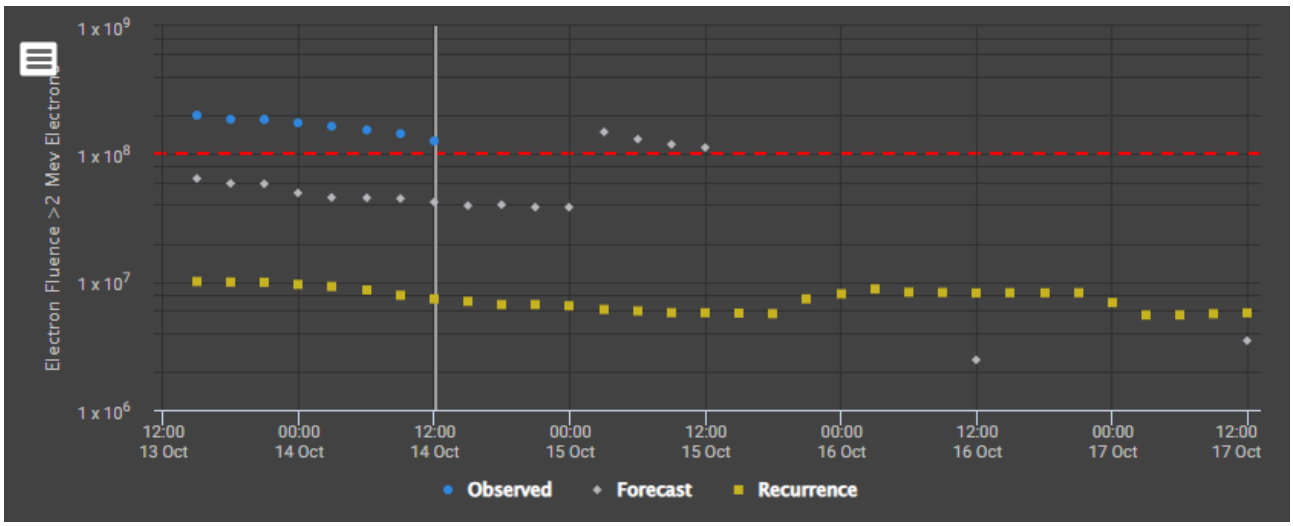
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV), as observed by GOES16, has dropped out in recent hours to near background levels. This is possibly due to the recent weak CME and HSS effects observed at Earth. Flux levels may recover somewhat during the period, especially if the current weak HSS does prove stronger than originally anticipated. However a further possible CME glancing blow on Day 4 (17 Oct) could knock the electron flux back down again.

The associated 24 hour fluence is currently above the Active (1e8 integrated pfu) threshold and is forecast to drop over the next 12 hours or so, likely below Active. A further rise is possible through the period, perhaps to near Active levels, although confidence is low. REFM is forecasting a trend below Active, although it is likely to be too slow to reduce levels below the Active threshold in the near term.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	30	40	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: REFM showing a declining trend, although the fluence is likely to drop below the Active threshold sooner than shown by REFM.



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